KEYLIGHT
BY THE FOUNDRY

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Keylight User Guide
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INTRODUCTION

Welcome to this User Guide for Keylight on Final Cut Pro.

Keylight is an industry-proven blue and green screen keyer. The core algorithm was developed by the Computer Film Company and has been further developed and ported to Final Cut Pro by The Foundry.

We hope you enjoy using Keylight.

About this Manual

Use the Quick Key chapter to see how a simple key is pulled using Keylight. The Basic Keying Chapter goes over the most common parameters you'll need to pull a variety of keys. The Advanced Keying Chapter explains how to tackle difficult keys.

Release Notes

For information on system requirements, new features, improvements, fixed bugs and known bugs & workarounds, see "Appendix A" on page 67.

Example Images

Example blue and green screen images for use with Keylight can be downloaded from our web site http://www.thefoundry.co.uk.

Installation on Mac OS X

To install Keylight on a Mac OS X machine, follow these instructions:

1. Download Keylight_2.0v3_FCP-mac-universal-release-32.dmg from www.thefoundry.co.uk and extract the package by double clicking on it.
2. Double click on Keylight_2.0v3_FCP-mac-universal-release-32.pkg
3. Follow the on-screen instructions to install Keylight.
4. Proceed to "Activating Keylight" on page 6.

Keylight can be found in the **Effects** > **Video Filters** > **Keylight** menu. Its parameters appear on the **Filters** tab of the Viewer.

If you at some point need to uninstall the plug-in, see "Uninstalling Keylight" below.

Uninstalling Keylight

The following directories are copied during the default installation process to the following paths. Removing these directories will uninstall Keylight:

/Library/Plug-ins/FxPlug/Keylight_2.0_FCP
/Applications/TheFoundry/Keylight_2.0_FCP

Activating Keylight

Once you have installed Keylight, you will need to activate the product. Successful activation gives you a license key that unlocks the software.

If you have a serial number for Keylight, you can activate the plug-in via the Internet or by telephone.

If you don't have a serial number for Keylight, you can activate the plug-in by telephone.

Activation via Internet

1. Start Final Cut Pro.
2. Select **Effects** > **Video Filters** > **Keylight** > **Keylight (2.0)** to apply the Keylight plug-in to an image sequence.
3. In the plug-in controls, press the **Help** button and make a note of your System ID (sometimes called host ID or lmhostid). This number is unique to your machine and your license key will be locked to it.
4. Press the **Enter Serial Number** button in the bottom left corner of the dialog.
5. This launches a web browser. Check that the System ID shown on the web page is correct. If it is not, or you wish to activate for a different computer, follow the on-screen instructions.
6. Type your serial number into the box provided. Make sure you type it in exactly as shown. Click **continue**.
7. If successful, you will be taken to a page that lets you download your license file and the Foundry License Installer (FLI). Click **download license**.
8. Double-click on the downloaded file to extract the license key and the Foundry License Installer (your computer may do this automatically). The license will be in a plain text file called foundry.lic. The license will look a bit like this:

```
INCREMENT keylight_fxplug_i foundry 1.0 permanent
uncounted \
HOSTID=0022411f0759 ISSUED=7-aug-2009 SIGN="0118 0259
3106 \
D626 F32A 54BC EA70 EFC6 AC23 0575 BD01 67F6 0D9B 9176
36A7 \
128A C706 C495 C017 34B8 8125"
```

   Once you have downloaded the license file, proceed to "Installing a License" on page 8.

Activation by Phone

Call our London office on 020 7434 0449 (country code 44) or phone our Los Angeles office on 310 399 4555. You will need your System ID ("System ID (lmhostid)" on page 8), an e-mail address for us to send the license key, and, if you have one, a serial number.

Installing a License

Once you have received your license file, you need to install the license. The Foundry License Installer (FLI) application helps you with this. You may have received this application in an e-mail or downloaded it from http://www.thefoundry.co.uk/licensing.

To install a license:

1. Open the directory where you have saved the license file and the Foundry License Installer.
2. Double-click on the Foundry License Installer application.
3. In the window that opens, click **Install**..

   This checks the license file and installs it into the correct directory.

You're good to go. Start Final Cut Pro and check whether Keylight is licensed. If it is not, check that you have a foundry.lic license file in the correct directory. See "Where Does the License File Go?" on page 9.

System ID (lmhostid)

The System ID (sometimes called host ID or lmhostid) is a unique number that identifies your computer. We use this number to generate a license key for that, and only that, computer.

The System ID is shown at the bottom of the help dialog. To

display this number, select **Effects** > **Video Filters** > **Keylight** > **Keylight (2.0)** to apply the Keylight plug-in and click on the **Help** button in its controls.

Where Does the License File Go?

The license file should be called foundry.lic and saved in the following directory as a plain text file:
/Library/Application Support/TheFoundry/FLEXlm/foundry.lic

There are also other places where you can place the license file. See "Alternative License Directories" on page 9.

Alternative License Directories

If you like, you can also put the license file in an arbitrary directory and point to it with the environment variable:
FOUNDRY_LICENSE_FILE

This can be useful for large post houses that have centrally managed license servers, but will not be necessary for most customers.

See "Further Reading" on page 10.

Watermark

If you don't have a valid license key, a warning will be displayed and the finished render will have coloured dots scattered over it.

License Problems

If you can't get your licenses to work, you can download the Foundry License Diagnostics (FLD) utility from http://www.thefoundry.co.uk/licensing. Run the FLD and e-mail the

resulting text file to support@thefoundry.co.uk with a clear description of the problem.

Error Log Files

If the plug-in fails to get a license, the incident is recorded in an error log file. The time, date and nature of the problem are appended to the end of the file. The error log file can then be found in the following location: /Library/Application Support/TheFoundry/FLEXlm/log/license.log

Further Reading

System Administrators may wish to find out more about licensing Keylight with FLEXlm. We recommend reading the Foundry FLEXlm Tools (FFT) User Guide available to download from our web site (http://www.thefoundry.co.uk/licensing). In addition, there are general FLEXlm licensing guides on Macrovision's web site (http://www.macrovision.com).

About The Foundry

The Foundry is a leading developer of visual effects software for film and video post production. Its products include Nuke, a high-end compositing application, and plug-ins, such as Furnace, Tinder, Tinderbox, Keylight, Ocula, and RollingShutter. The plug-ins run on a variety of compositing platforms, including After Effects, Autodesk® Media and Entertainment Systems, Avid DS, Nuke, Shake, and Final Cut Pro. For the full list of products and supported platforms, see our web site http://www.thefoundry.co.uk.

Nuke is an Academy Award® winning compositor. It has been used to create extraordinary images on scores of

feature films including *The Dark Knight*, *The Golden Compass*, *Iron Man*, *Transformers*, *King Kong*, and *Pirates of the Caribbean: At World's End.*

Furnace is a collection of film tools. Many of the algorithms utilise motion estimation technology to speed up common compositing tasks. Plug-ins include wire removal, rig removal, steadiness, deflicker, degrain and regrain, retiming, and texture tools.

Tinder and Tinderbox are collections of image processing effects including blurs, distortion effects, background generators, colour tools, wipes, matte tools, painterly effects, lens flares, and much more.

Ocula is a collection of tools that solve common problems with stereoscopic imagery, improve productivity in post production, and ultimately help to deliver a more rewarding 3D-stereo viewing experience.

RollingShutter is a plug-in that tackles image-distortion problems often experienced by users of CMOS cameras. The plug-in will often vastly improve the look of distorted footage, by either minimising or eradicating image distortions. Unlike solutions tied to camera stabilisation, that stretch the image as a whole, the RollingShutter plug-in compensates for local skewing and distortion in the scene, by correcting each object individually.

Visit The Foundry's web site at www.thefoundry.co.uk for further details.

About CFC and Framestore

The Computer Film Company (CFC) pioneered the field of digital film compositing and today operates a state of the art film effects facility in London under the name Framestore. The company has always invested in research, and maintains the kind of edge that has twice been honoured with Technical Achievement Awards from the Academy of Motion Picture Arts and Sciences.

Visit Framestore's web site at http://www.framestore.com for further details.

GETTING STARTED

Introduction

Keylight has been refined over a number of years to make keying quicker and easier while providing a depth to the tools that will tackle even the most challenging shots.

Keylight was first developed by The Computer Film Company to help with difficult keys in feature films. Over the years Keylight has been refined in production on hundreds of films.

Notation

When we refer to blue screens throughout the text we mean, of course, blue or green screens

Quick Key

Keylight is available from the Effects > Video Filters > Keylight in Final Cut Pro.

Consider this shot from The Saint, pictures courtesy of CFC and Paramount British Pictures Ltd.

Figure 1. Blue Screen.

Figure 1 is the blue screen foreground that should be

composited over the background shown in Figure 2.

Figure 2. Background.

If you want to have a go of this shot, you can! The images can be downloaded from our web site and this quick key is also covered in the Tutorial Chapter. See "Tutorial 1: Simple Key" on page 51.

Throughout this user guide we assume a good understanding of Final Cut Pro. To perform this quick key, do the following:

1. Create a new composition using SaintFG.mov and SaintBG.mov. Layer the clips with the blue screen over the background as shown in Figure 3.

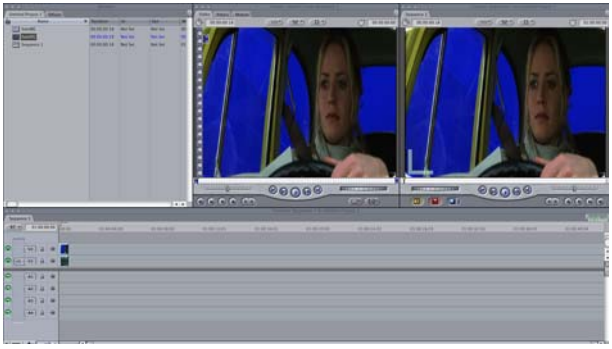

Figure 3. Screen Shot showing Saint blue screen.

2. Open the blue screen clip (SaintFG.mov) in the Viewer and apply Keylight from Effects > Video Filters > Keylight > Keylight (2.0). See Figure 4.

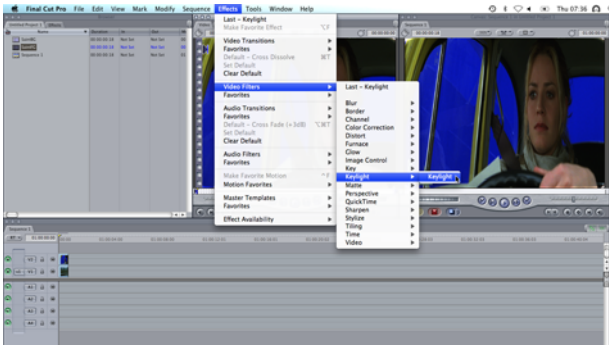

Figure 4. Apply Keylight from the Effects > Video Filters menu.

3. The Keylight parameters appear on the Filters tab of the Viewer, as shown in Figure 5.

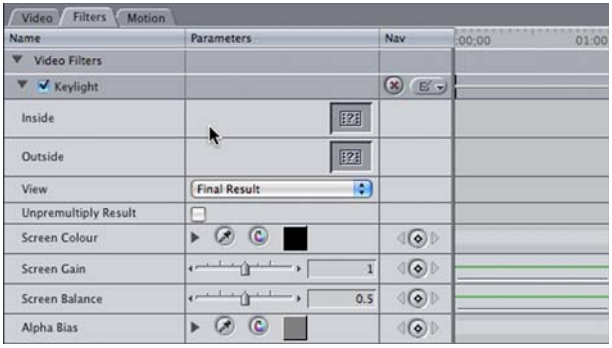

Figure 5. Keylight Parameters.

4. To view the Keylight parameters and the foreground clip in separate Viewers, right-click on SaintFG.mov in the Browser

and select Open in New Viewer. This opens the foreground clip in a new Viewer, as shown in Figure 6.

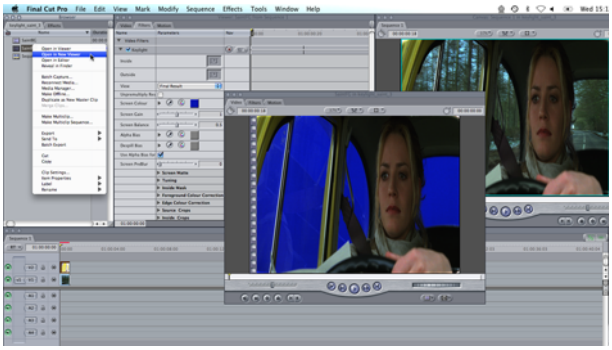

Figure 6. Opening a new Viewer.

5. In the Keylight controls, select the Screen Colour eye dropper and click on the blue screen in the new Viewer. A good place to pick is the blue from the back windscreen as this has no reflections. Picking this blue will key the back windscreen perfectly leaving reflections in the side window.

Figure 7. Pick the blue from the back windscreen.

6. That's it. In many cases this is all you will need to do to perform a key, since selecting the screen colour creates a matte and

despills the foreground. The final composite is shown in Figure 8.

Figure 8. Final composite.

There are a couple of extra steps that can be taken to fine tune this key and these are discussed in "Tutorial 2: Fine Tuning a Key" on page 56.

Picking the screen colour may be enough for a lot of keys, but there are many more tools within Keylight that can be used to tackle more complicated shots. These are described in later chapters.

BASIC KEYING

The following section describes the parameters you need to do basic keying. This will give you enough to tackle most simple keys. A discussion of advanced parameters to fine tune and tackle complex keys can be found in the next chapter.

Basic Workflow

The first step is always to pick the **Screen Colour**. Then view the composite and the screen matte.

If there is blue spill on the composite, pick skin tones for the **Despill Bias** from the foreground actor.

If the background is showing through the foreground or the foreground is showing on the background, you need to improve your matte using the **Clip Black** and **Clip White** parameters. In the next chapter, we'll look at ways of doing this with inside and outside masks.

Screen Colour

The Screen Colour is probably the most important parameter, and you should always pick the screen colour before doing anything else. It should be set to the colour of the green or blue curtain behind the foreground object.

When picking the screen colour, it is often useful to open the foreground image in a new Viewer. This way, you can adjust the Keylight controls in the original Viewer, pick the screen colour from the new Viewer, and view the output in the Canvas. To do so, right-click on the foreground clip in the

Browser and select Open in New Viewer, as shown in Figure 9.

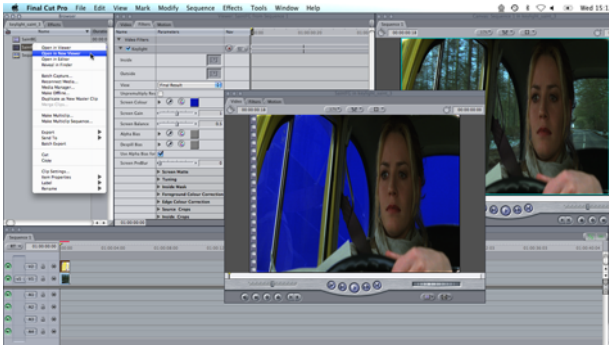

Figure 9. Opening the foreground image in a new Viewer.

To set the Screen Colour, select the eye dropper in the Keylight controls, and pick the colour from the new Viewer. Setting the Screen Colour will create a matte (the Screen Matte), set the Screen Balance, and despill the foreground. In some cases, this is enough to get a decent key. For more information on Screen Colour see page 25.

Figure 10 shows a well lit blue screen behind an actor.

Figure 10. Blue Screen.

You should note that repeatedly picking the Screen Colour will override any previous selections. It will not add to previous selections and key more of the image with each click.

Note *You should always pick screen colours from the Source image and not the Final Result.*

Tip

It's worth picking several different blues, and for each one viewing the matte and status to judge the key.

View

After picking the Screen Colour, it's useful to be able to check the quality of the key by viewing the composite and the screen matte. You can do this using the View Menu, shown here in Figure 11.

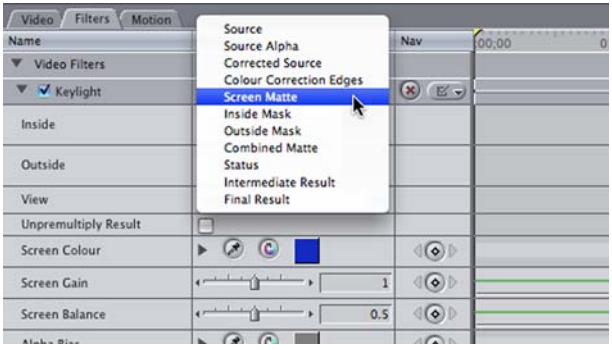

Figure 11. View Menu.

The options you'll use the most are:

- **Screen Matte** – this renders the matte created by picking the screen colour.

- **Status** - this renders an exaggeratted view of the mattes so that minor problems are shown clearly.
- **Final Result** - this renders the foreground composited over the background using all mattes, spill and colour corrections.

Status

The Status is one of the options in the View menu and shows an exaggerated view of the key so that you can make a more informed decision when refining the composite.

Figure 12. Green Screen.

Figure 13. Status.

Figure 13 shows the Status display after the screen colour has been picked from the image shown in Figure 12. Three colours are displayed. Black pixels show areas that will be pure background in the final composite. White pixels show areas that will be pure foreground. Mid-grey pixels will be a blend of foreground and background pixels in the final composite. You need grey pixels around the edge of the foreground to get a good key at the foreground edge. However, if there are grey pixels where there should be pure background, you should try to remove these with the **Screen Gain**, **Clip Black** or **Outside mask**. If you have grey pixels where there should be pure foreground, this tells you that parts of the background will show through here and you will

need to firm up the foreground with **Clip White** or an **Inside mask**.

Pixels that are a blend between the foreground and background are shown in just one shade of grey. This is done to highlight potential problems with the key. These grey pixels may represent a foreground/background blend of 50/50 or 99/1. No distinction is made as to this ratio.

You may occasionally see other colours in the Status View and these are covered on page 37 in the Advanced Keying Chapter.

Despill Bias

Although the foreground is despilled automatically, you may find the need to pull out a little more of the screen colour after picking from the image. You can do this with the Bias controls.

Figure 14. Exaggeratted blue spill.

Figure 15. Despill Bias used to remove the blue spill.

By default, the Alpha Bias colour is used for Despill Bias, which in the vast majority of cases, is the best way to use these controls. See "Why are there two Bias Colours?" on page 30 in the Advanced keying section for a look at a case

where unlinking the bias controls is a good tactic.

Thus, using the Alpha Bias control colour dropper, pick the predominant foreground colour. In the majority of cases, it's best to pick skin tones from the foreground actor, as viewers tend to be most tuned to colour shifts in these areas.

ADVANCED KEYING

The following section describes the parameters you need to fine tune keys and get the most out of Keylight. Basic parameters covered in the previous chapter may also be covered here in more detail.

Screen Colour

The Screen Colour represents the colour of the pure blue (or green) screen. The first thing you should do when pulling a key is pick the Screen Colour. This single colour has a primary component, blue or green, and that has a saturation. Once the screen colour has been picked, Keylight analyses all the pixels in the image and compares the saturation of the primary component in each of these pixels with the corresponding saturation of the screen colour, setting the alpha and modifying the colour accordingly.

Tip

Picking different shades of blue or green from the background can give quite different results. It's worth experimenting with different screen colours if your initial pick didn't give a good key.

Background Pixel

If the saturation of the pixel in the image is as strong or

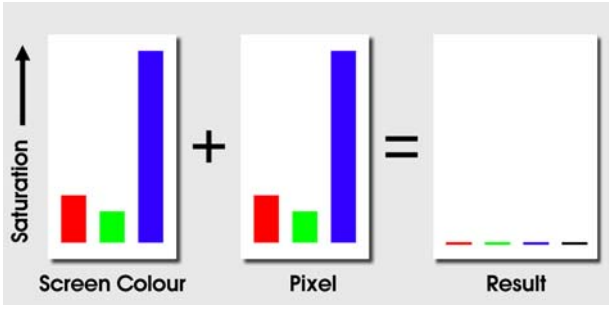

Figure 16. Blue screen pixel set alpha to zero.

greater than the screen colour, then it'll be a pixel from the blue screen background, and that pixel will be set to completely transparent and black. See Figure 16.

Edge Pixel

If the saturation of the pixel is less than the screen colour, then it'll be the edge of the foreground object, and we

subtract some of the screen colour from the pixel (de-spilling) and set the image to semi-opaque. See Figure 17.

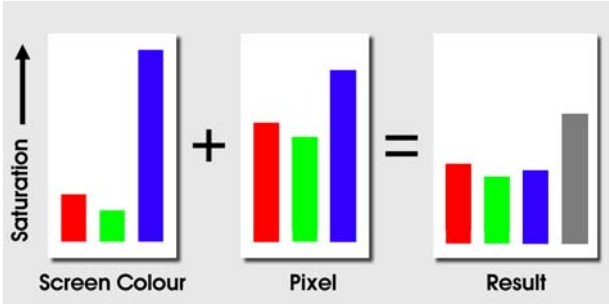

Figure 17. Edge pixel gives partial alpha.

Foreground Pixel

If the primary component in the pixel is not the same as the primary component of the screen colour, we have a foreground pixel, and the alpha is set to completely opaque. The pixel colour is not modified. See Figure 18.

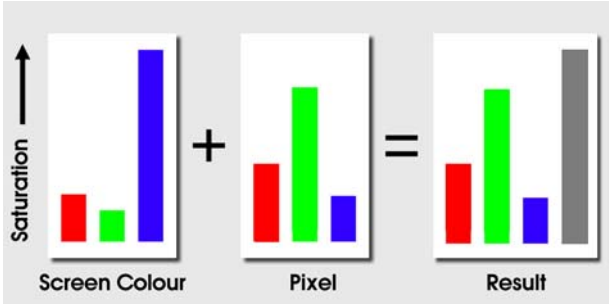

Figure 18. Foreground pixel gives full alpha.

Note *You should note that the Screen Colour is a single colour. You are not picking lots of colours that are keyed out.*

Biasing

What's biasing all about? Biasing in Keylight was originally developed for a shot in the motion picture "Executive Decision". The foreground consisted of reddish browns, but a combination of factors led to the 'green screen' being lit so that its primary component was actually slightly red.

Figure 19. Is this the worst green screen you've ever seen?

So what happens when we pick the screen colour? Well because the screen was 'red', as is the foreground, our pilot ends up being keyed out as shown in Figure 20.

Figure 20. Default key showing the transparency in the foreground as a result of picking the "red" screen colour.

Not a great result, I'm sure you'll agree, and much pressure

was applied to the lowly programmers to get around the problem.

A work around to this is to manually colour correct the image so that the background is properly green, pull the key from this corrected image, then 'un-correct' the result of that so that the foreground colours match the original. A corrected image would look something like the one shown in Figure 21. The green screen is now strongly green and distinct from the foreground colours. Notice also the red cast on the pilots mask has been removed and turned into a neutral grey.

Figure 21. Colour corrected image that would give a better key.

This is effectively how the Keylight developers got around the problem. They introduced the concept of a 'bias' colour, which is a colour cast that is removed from the source image and screen colour, then a key is pulled from this modified image, then the colour cast is put back. In essence this automates the 'work around' described above, however it is done in a way that does not slow Keylight down at all. For our Executive Decision shot, an appropriate colour is the red cast on the pilot's mask in the source footage. Setting our bias to this now gives us the far better result as shown in

Figure 22.

Figure 22. Final Key, with the Bias Colour Set to the Value of the Pilot's Mask.

The Bias Colours in everyday use

It also turns out that the bias colour is actually useful for situations without strong casts, typically where there is some colour spill around the edge of keys. By setting the biases to the main colour that occurs near the edge of the foreground (typically flesh tones or hair tones), you allow Keylight to better discriminate between foreground and background.

Picking a Bias Colour

To pick a bias colour, activate the colour picker under Alpha Bias and click on the image foreground to select a colour.

Why are there two Bias Colours?

Remember that Keylight does two things, calculates a transparency and removes the screen colour from the foreground. By default, one bias colour, the 'Alpha Bias', is used for both operations. This works fine in most situations, for example, the Executive Decision shot above.

However, sometimes you can pick a bias that gives a great alpha, but performs a poor despill, and another bias that gives a great despill, but a poor alpha. Consider the blue screen from the TV series Merlin, courtesy of CFC Framestore shown below in Figure 23.

We pick the strong blue of the background without choosing an alpha bias, and end up with the lovely alpha shown in Figure 24, but the despill resulting from this key is poor as shown in Figure 25 on page 32.

Figure 23. Merlin blue screen.

Figure 24. Nice Alpha.

We can pick an alpha bias to get a better despill, but this destroys our nice alpha. The way around this is to turn off the 'Use Alpha Bias for Despill', which gives you a separate bias factor to use solely for despill calculations. If you then pick the 'Despill Bias' to be something from Miranda Richardson's hair or skin tone, you will keep the nice alpha,

and get a good despill as well (Figure 26).

Figure 25. Poor despill.

Figure 26. Final Key, Using Separate Despill and Alpha Biases.

Screen Gain

The screen gain controls how much of the screen colour is removed to make the screen matte. Increasing this value will

Figure 27. Status after picking the Screen Colour.

Figure 28. Status showing the increase in Screen Gain.

key more. For the most part, a better way of improving the matte is using the Clip Black and Clip White controls. Figure 27 shows the Status after picking the screen colour. You can clearly see that parts of the background are grey where they should be black. When composited you may see faint pixels from the foreground where you should be seeing pure background. Increasing the screen gain will fix this, as

shown in Figure 28, but increasing it too much will destroy your good work. Like many keying parameters it's a balance – not too much, not too little. Increasing the screen gain too much will lead to the background showing through the foreground and edge detail will be destroyed. Figure 30 shows this quite well.

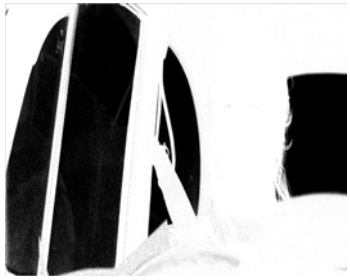

Figure 29. Screen Gain = 1 giving a good screen matte.

Figure 30. Screen Gain = 1.5 giving background show through and over eroded edges.

Note the steering wheel is black when it should be white. If you look at the composite you will see the background showing through here. Also, some of the fine hair detail on the actor, visible in Figure 29, has been eroded in Figure 30.

Screen Balance

Saturation is measured by comparing the intensity of the primary component against a weighted average of the two other components. This is where the **Screen Balance** control comes in. A balance of 1 means that the saturation will be measured against the smallest of the other two components in the screen colour.

A balance of 0 means that the saturation will be measured against the larger of the other two components. A balance of

0.5 will measure the saturation from the average of the other two components.

The appropriate balance point for each image sequence you key will be different depending on the colours in that image. Generally speaking, blue screens tend to work best with a balance of around 0.95 and green screens with a balance of around 0.5. These values are selected automatically the first time you pick the screen colour. If the key is not working too well with these settings, try setting the balance to about 0.05, 0.5, and 0.95 and see what works best.

Clip Levels

The clip levels are adjusted using two parameters – **Clip Black** and **Clip White**. Any alpha value at or below Clip Black will be set to zero and any alpha value at or above Clip White will be set to 1. Figure 31 shows the original alpha of an image and Figure 32 shows the result of clipping it.

Figure 31. Clip Black = 0.

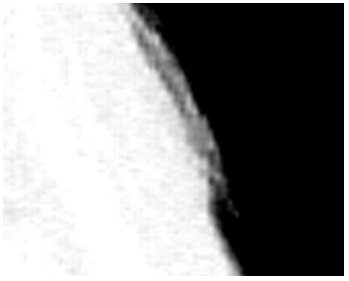

Figure 32. Clip Black = 0.5.

Notice how the grey areas in the black background have been reduced and that the grey edges have hardened up considerably. When compositing, the Clip Black control can be used to improve the background image if parts of the foreground are showing through. The Clip White control on

the other hand can be used to firm up the centre of the matte, making it less transparent to the background.

Note *You need to be really careful if you chose to use Clip Black and Clip White that you don't destroy the edges on your foreground. It is possible to use Clip Rollback to compensate for this.*

View

After picking the Screen Colour, it's useful to be able to view the key in different ways. You can do this using the View Menu, shown here in Figure 33.

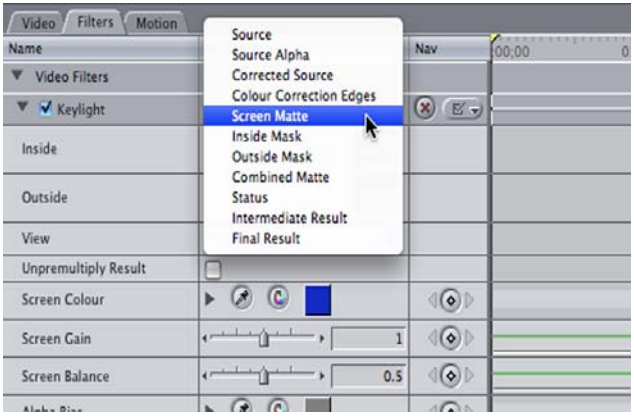

Figure 33. View Menu.

Here's the complete list of options and what they do.

- Source – displays the blue or green screen.
- Source Alpha – displays the alpha channel embedded in the blue or green screen.
- Corrected Source – displays the uncomposited source image with any colour corrections applied.

- Colour Correction Edges – displays the foreground edges as a matte that will be colour corrected using the controls in the Edge Colour Correction folder.
- Screen Matte – displays the matte created as a result of picking the screen colour.
- Inside Mask – displays the mask that firms up the foreground.
- Outside Mask – displays the mask that cleans up the background.
- Combined Matte – displays all the screen matte, inside and outside masks and any source alpha added together. The combined matte is used to composite the foreground over the background layer.
- Status – displays an exaggerated view of the key so you can make a more informed decision on how to improve the result. See "Status" on page 36.
- Intermediate Result – is used for multipass keying. The alpha is set as per normal, but the RGB values are not modified from the original source image.
- Final Result – renders the foreground composited over the image on the background track. This image is premultiplied. In other words, the RGB values of pixels have been multiplied by their corresponding alpha channel values.

Status

The Status view is one of the options in the View menu and shows an exaggerated view of the key so that you can make

a more informed decision when fine tuning the composite.

Figure 34. Green Screen.

Figure 35. Status.

Figure 35 shows the Status after the screen colour has been picked from the image shown in Figure 34. Three colours are displayed. Black pixels represent pure background in the final composite. White pixels are pure foreground and grey pixels are a blend of the foreground and background pixels. The grey is just one colour to highlight any areas that are not pure foreground or background. Grey pixels do not mean the key is poor – the final composite may be fine.

You may occasionally see other colours in the Status view.

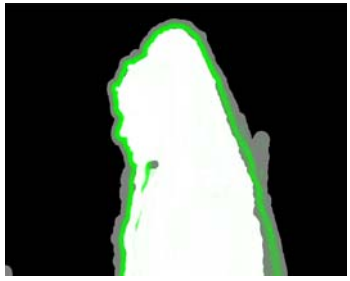

Figure 36. Status showing processing of the Screen Matte.

Figure 37. Result showing Screen Replace Colour.

Figure 36 shows black, white, grey and green pixels. The

green pixels are a warning. They show you the parts of the Screen Matte that have changed through processing the matte (clipped, softened or eroded). These areas have had the correct amount of spill removed, but the alpha has subsequently changed and the composite may no longer look right. This can be corrected using the Screen Replace Colour to put back colour in these areas. Figure 37 on page 37 is an extreme example to illustrate the point. The Replace Colour has been set to pure red and you can see that this mirrors the green pixels in the Status View.

Similarly, you may see blue pixels in the Status.

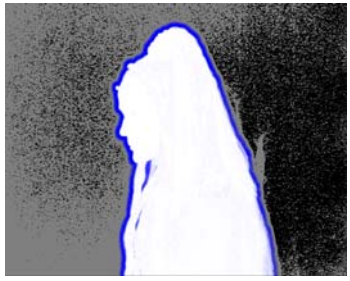

Figure 38. Status showing how the Inside Mask will affect the foreground.

Figure 39. Final Result showing the Inside Replace Colour.

These represent processed pixels in the Inside Mask that affect the despill of the foreground. The Inside Replace Colour will be used to modify these pixels. Another extreme example is shown in Figure 39. The Inside Replace Colour is set to pure yellow and Inside Replace to Hard Colour.

You may also see dark red pixels which indicate areas where an outside mask has been used to reduce the transparency of the image.

Unpremultiply Result

Use this switch to set the premultiplication of the RGB channels in the output image. If turned off, the RGB values will be multiplied by the alpha channel, thus transparent areas are always black, and semi-transparent areas are dark. If turned on, the RGB values of the output image will be not multiplied by the alpha, thus semi-transparent pixels will have full brightness in the RGB channels.

If colour correcting the image after applying Keylight you should switch on Unpremultiply Result.

Screen Matte

The Screen Matte (Figure 41) is the result of pulling the blue or the green from the image (Figure 40) and making those regions transparent.

Figure 40. Green screen.

Figure 41. Screen Matte.

Once you have done this, you will want to firm up the foreground (make it more white) and clean up the background (make it more black). This can be done by processing the Screen Matte.

Clip Rollback

Pulling a Screen Matte (Figure 42) will typically produce lots of transparency (grey) in the matte at the edges. This is good since this is what you need to key hair well. You may also get transparency in the foreground as shown in Figure 43. This is bad as your subject will appear slightly see-through, and this should be corrected. You can do this with an inside mask

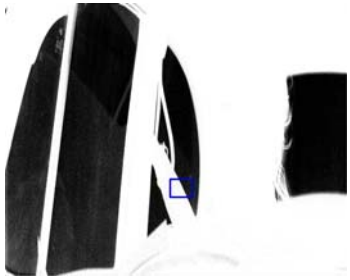

Figure 42. Screen matte highlighting the close up view as shown in Figure 43.

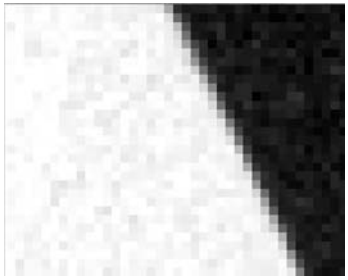

Figure 43. Close up screen matte showing unwanted (grey) transparency in the (white) foreground.

shape, or you can use the Clip White parameter to turn these grey pixels white. This cleans up the foreground (Figure 44) but it will also destroy the edge detail you want to keep. This is where Clip Rollback comes in. This is used to put back the edges to restore the detail that was lost. A rather

exaggerated clip rollback is shown in Figure 45 to illustrate the point.

Figure 44. Clip White has been used to remove the unwanted grey pixels in the white matte.

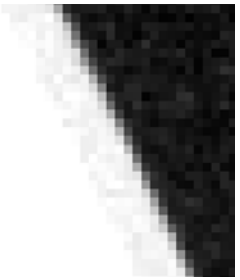

Figure 45. Clip Rollback has been used to reduce the unwanted erosion of the edge.

Screen Dilate

This control should not normally be used as eroding the edges can produce a very poor key. However, the Screen Dilate parameter allows you to grow (if greater than zero) or shrink (if less than zero) the alpha in the Screen Matte. These controls are sub-pixel accurate.

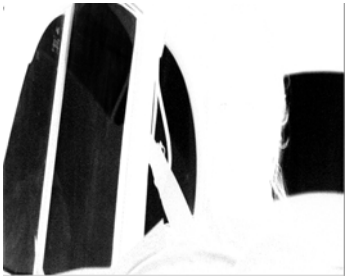

Figure 46. Screen Matte.

Figure 47. Eroded Matte.

Screen Softness

Occasionally, it is useful to be able to blur the matte. Use **Screen Softness** for this. The most common example would be to pull a very harsh matte that you would use as an inside matte further down the tree. For this you'd soften and erode the screen matte.

Screen Despot

This controls how much to simplify the matte. It coagulates similar regions so that, for example, black specks in the white matte can be absorbed by the surrounding white areas. Increasing the Screen Despot Black will remove isolated spots of black in the white matte. Increasing Screen Despot White will remove isolated spots of white in the background up to that size.

Figure 48. Eroded matte.

Figure 49. Despot.

Screen PreBlur

Some shots can be improved by softening the foreground image that is used to generate the key. The original image is then used in the composite and colour corrections. The Screen PreBlur parameter is used to do this. DV footage or grainy shots may benefit from subtle use of this control.

Tuning

Keylight creates the screen matte after the screen colour has been picked. You can make fine adjustments to this matte using the gain controls. Increasing the gain controls makes the screen matte more transparent by increasing the amount of screen colour showing through the matte. This tends to tint the edges the opposite of the screen colour (for blue screens, edges become yellow). Decreasing the gain makes the main matte more opaque by reducing the amount of screen colour showing through the matte.

The matte can be adjusted independently in the shadows, midtones, and highlights giving more control than the clipping levels.

The level of the midtones can be adjusted too. For example, if you are working on a dark shot you may want to set the midtone level to a dark grey to make the gain controls differentiate between tones that would otherwise all be considered shadows.

Colour Replacement

Remember that Keylight does two things - it removes the screen colour to despill the image and generates an alpha (Screen Matte) to composite the foreground over the background layer.

If you then process the Screen Matte, for example, by eroding the matte or changing the clip levels, Keylight will be removing the wrong amount of screen colour from the pixels whose transparency have now changed. The **Replace** controls instruct Keylight how to deal with such pixels. The Status will display which pixels use a replace method. Those pixels who use a replace method because the Screen Matte processing tools modified the transparency will be green,

whilst those pixels whose transparency was modified by the inside mask will be blue. See the Status View on page 37.

There are four options to the replace method, these are:

1. **None -** the despilled image is left untouched if the alpha is modified.
2. **Source -** the image will have a corresponding amount of the original pixel (screen colour and all) reintroduced/removed if the alpha is changed.
3. **Hard Colour -** the despilled image has a corresponding amount of the replace colour added for any increase in alpha.
4. **Soft Colour -** the despilled image has a corresponding amount of the replace colour added for any increase in alpha, however, it attempts to modulate the luminance of the resulting pixel so that it matches the original pixel. This will give a more subtle result than the Hard Colour option.

Inside & Outside Masks

If you can't adequately improve the Screen Matte using the Clip Levels, you can input a mask that defines the foreground or background. The Inside mask makes the foreground less transparent and the Outside mask is used to clean up the background that might have bits of the foreground showing through. The Outside mask is often used to clean up screens

that are not a constant colour or have lighting rigs in shot (Figure 50) by forcing the alpha transparent.

Figure 50. Green Screen with lighting rig visible.

The Inside mask can be used to keep elements in the foreground that you don't want to lose (an actor's blue eyes in front of a blue screen). These masks should normally be softened to blend into the Screen Matte.

Figure 51 shows a mask drawn around the lighting rig on the left side of the screen. When this is used as the Outside mask clip and the View control set to render the Outside Mask, you will see the image displayed in Figure 52.

Figure 51. Mask drawn round the lighting rig.

Figure 52. Mask used as an Outside Mask and Viewed.

The Outside mask forces that part of the image to be in the background thus keying out the rig. The Screen Matte shown in Figure 53 shows the matte pulled when the green screen is picked. When the Outside mask is subtracted from the Screen Matte we get the Combined Matte, shown in Figure 54.

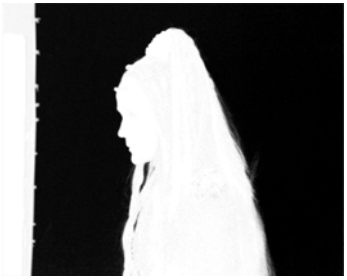

Figure 53. Screen Matte.

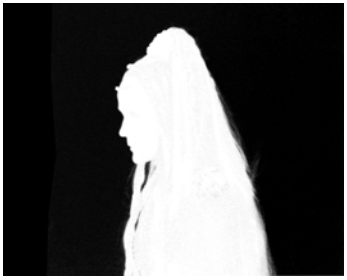

Figure 54. Combined Matte.

Here, you can see the change in the matte that will result in the lighting rig being keyed out in the final composite. If more than one mask is required to remove garbage, then use the masks to create an embedded alpha channel in the image and set the Source Alpha to Normal. See "Source Alpha" below.

Source Alpha

This parameter determines how to deal with any embedded alpha in the original image.

- **Ignore** - this will not use any embedded alpha in the key.
- **Add To Inside Mask** - the embedded alpha is added to the inside mask.
- **Normal** - the embedded alpha is used to key the layer as normal. It is added to Keylight's screen matte and can be useful if requiring complicated multi-shaped masks to rotoscope out garbage.

Foreground Colour Correction

The Foreground Colour Correction parameters allow you to modify the foreground colours in your composite. In particular, reflected blues and greens from the screen can be suppressed.

Enable Colour Correction - enables foreground colour correction and all the tools that control this feature.

Saturation – this control will increase or decrease the colour saturation of the image, making colours more or less intense.

Contrast – the contrast is the ratio of brightest tones to the darkest. Increase this value for a contrasty image and decrease it to wash it out.

Brightness – the brightness equates to the overall luminance of the image. Increase this value to make the image lighter and decrease this value to make it darker.

Suppress – this controls colour suppression in the image. You can choose to remove a specific primary, either Red, Green, Blue or their complements, Cyan, Magenta or Yellow. For green screens you may find it helpful to suppress green.

Suppression Balance – determines what to reduce the suppressed component to. If set to 0%, it will be the smallest of the other two components, if set to 100% it will be the largest of the other two components. Otherwise, it will be to a balanced average.

Suppression Amount – determines how strongly you want to reduce the indicated component.

Balance - these controls are used to alter the colour balance

of the image. Choose a hue and saturation (via the colour sampler, the sliders or the colour balance wheel) to shift the entire colour balance of the image.

Edge Colour Correction

The Edge Colour Correction parameters allow you to colour correct edges to seat the composite into the background. To see the areas considered an edge that you will be affecting, select the Colour Correction Edges from the View menu.

Enable Edge Colour Correction – use this option to separately colour correct edges of the image independently from the overall colour correction.

Edge Hardness – this determines how strongly to blend between the edge correction and the main correction.

Edge Softness – this will soften the region considered to be the edge by this amount (in pixels).

Edge Grow – this will grow the region considered to be the edge by this amount (in pixels).

Edge Saturation – these controls determine how much to scale the saturation of the image.

Edge Contrast – this control increases/decreases the contrast on the region considered to be the edge.

Edge Brightness – this control brightens the region considered to be the edge.

Edge Suppress – Choose to completely remove a specific primary, either Red, Yellow, Green, Blue or their components,

Cyan, Magenta, or Yellow.

Edge Suppression Balance – determines what to reduce the suppressed component to. If set to 0, it will be the smallest of the other two components, if set to 1 it will be the largest of the other two components. Otherwise, it will be to a balanced average.

Edge Suppression Amount – determines how strongly you want to reduce the indicated component.

Edge Balance – these controls are used to alter the colour balance of the image edges. Choose a hue and saturation (via the colour sampler, the sliders or the colour balance wheel) to shift the colour balance of the edges.

Source Crops

The Source Crops enable you to quickly cut out lighting rigs or other unwanted elements using vertical and horizontal lines.

Keylight requires access to source pixels that lie off the edge of the source image. The cropping controls provide access to all the controls required for specifying how pixels are treated at these edges and where they appear. The built-in crop controls are also useful for removing unwanted black pixels at the edge of video footage.

X Y Method – determines the behaviour of the image at the left and right crop boundaries. Four edge methods are supplied:

- **Colour –** fills the area between the crop line and the edge with the Edge Colour.

- **Reflect –** reflects pixels about the current crop line. In other words, it copies pixels from the other side of the current crop line into the area between the current crop line and the screen edge.
- **Repeat –** copies pixels on the crop boundary to the screen edge.
- **Wrap** – copies pixels from the area between the opposite crop line and its screen edge to the area between the current crop line and its screen edge.

Note *Horizontal and vertical crop boundaries can have different edge methods. Cropping is often used to remove unwanted pixels at the edge of an image. If a video clip is digitized badly, you may get black edges left and right. These can be easily removed by moving the vertical crops and setting the edge method to Reflect.*

Edge Colour – sets the fill colour used when the edge method is set to Colour.

Left, Right, Top, Bottom – use these controls to set the crop positions. Lines will be overlaid in the display enabling you to set the various positions by eye.

Note *The position of the crop lines can be changed by clicking and dragging them directly on the screen.*

Inside and Outside Crops

The crops controls described above also exist for Inside and Outside masks.

TUTORIAL

Introduction

We have included several tutorials with example images that you can use to practice Keylight.

- Tutorial 1: Simple Key
- Tutorial 2: Fine Tuning a Key
- Tutorial 3: Extreme Blue Spill
- Tutorial 4: A Red Green Screen

Example Images

The tutorial images referred to in this chapter can be downloaded from our web site http://www.thefoundry.co.uk.

Tutorial 1: Simple Key

Using the blue screen clip from The Saint, you will composite the actor over the background. You will learn how to:

- Apply Keylight to a clip.
- Pick the Screen Colour.
- View the Final Result.

The clips you will need for this task are called SaintFG.mov and SaintBG.mov, pictures courtesy of CFC and Paramount British Pictures Ltd. for the film The Saint. You should import them into Final Cut Pro and create a new sequence

containing the blue screen of Elizabeth Shue layered over the road.

Figure 55. Blue Screen - SaintFG.mov

Figure 55 is the blue screen foreground that should be composited over the background shown in Figure 56.

Figure 56. Background - SaintBG.mov

1. Create a new sequence using SaintFG.mov and SaintBG.mov, layer the clips with the blue screen over the background as shown in Figure 57.

Figure 57. Screen Shot showing Saint blue screen.

2. Open the blue screen clip (SaintFG.mov) in the Viewer and apply Keylight from the Effects > Video Filters > Keylight menu. See Figure 58.

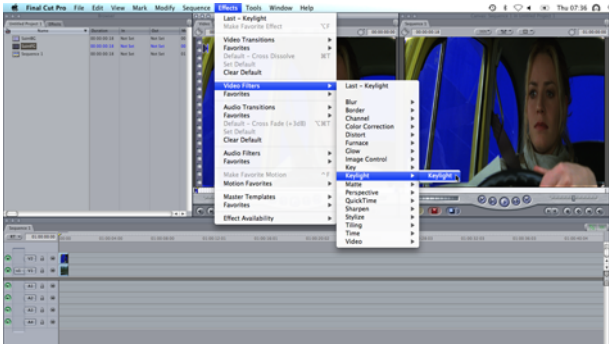

Figure 58. Apply Keylight from the Effects > Video Filters > Keylight menu.

3. The Keylight parameters appear on the Filters tab of the Viewer. They are shown in Figure 59.

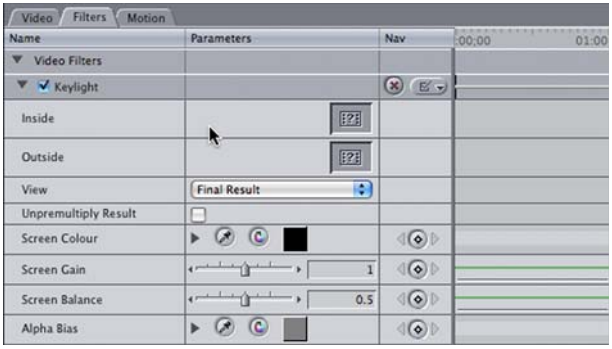

Figure 59. Keylight Parameters.

4. To view the Keylight parameters and the foreground clip in separate Viewers, right-click on SaintFG.mov in the Browser and select Open in New Viewer. This opens the foreground clip in a new Viewer, as shown in Figure 60.

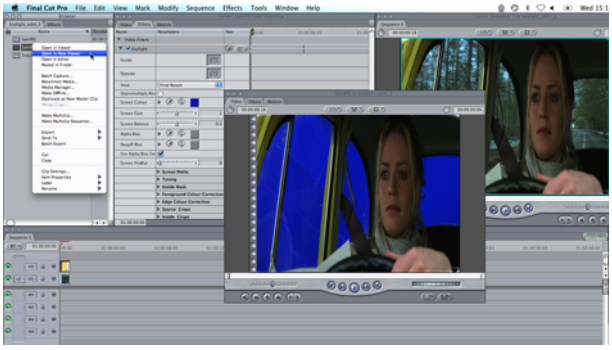

Figure 60. Opening a new Viewer.

5. In the Keylight controls, select the Screen Colour eye dropper and click on the blue screen in the new Viewer

window. A good place to pick is the blue from the back windscreen as this has no reflections. See Figure 61.

Figure 61. Pick the blue from the back windscreen.

6. That's it. In many cases this is all you will need to do to perform a key, since selecting the screen colour creates a matte and despills the foreground. The final composite is shown in Figure 62.

Figure 62. Final composite.

There are a couple of extra steps that can be taken to fine tune this key and these are discussed in the next tutorial on page 56.

Tutorial 2: Fine Tuning a Key

Using the images from the film The Saint, you will learn how to fine tune the key pulled in Tutorial 1. You will learn how to:

- Use Status to judge the quality of the key.
- Use the Screen Gain to improve the background.
- Use the Despill Bias to remove more blue spill.

1. Create a new composition using SaintFG.mov and SaintBG.mov. Apply Keylight.
2. Open a the SaintFG.mov clip in a new Viewer. Select the Screen Colour eye dropper and click on the blue screen in the new Viewer.

Note *These steps were covered in greater detail in the previous tutorial.*

3. Before we do anything else, we need to look at the quality of the key so far. On first inspection, the composite looks pretty good, but it's hard to judge. To see any potential problems more clearly, switch to the Status view as shown in Figure 63.

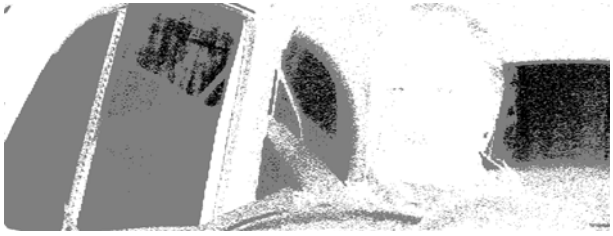

Figure 63. Status showing grey pixels in the background.

Here, we can see that the windscreens are a mixture of black and grey pixels. The black pixels tell us that pure background will be seen here in the final composite. The grey pixels tell us that there will be a mix of foreground

and background pixels. What we want is a clean background showing through the windows, but with some reflections in the side window preserved. In other words we need mostly black pixels with a few grey ones.

4. Figure 64 shows the Status view that we're aiming for. The background has been cleaned up and we still have some reflections in the side window. To get this you should increase the Screen Gain from 1 to 1.12.

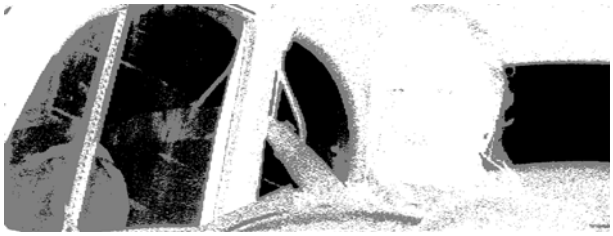

Figure 64. Improved background with Screen Gain.

5. Finally, if you look closely at the composite you will see a tiny amount of blue spill on the woman's hand and in her hair. This was from reflected light from the blue screen. Pick skin tones for the Despill Bias to remove it.

Figure 65. Final Composite.

Tutorial 3: Extreme Blue Spill

This is a really interesting clip from the film Merlin. The results with Keylight are certainly not perfect, indeed it is unlikely that you will ever end up with a truly realistic looking shot. However, there are some interesting things to observe. You will learn how to:

- Reduce the blue spill using Screen Balance and Despill Bias.
- Improve the foreground opacity using Alpha Bias.

1. Load the MerlinBlueFG.mov (Figure 66) and Merlin-BlueBG.mov clips and apply Keylight.

Figure 66. A tricky blue screen.

2. Open the MerlinFG.mov clip in a new Viewer and pick the Screen Colour using the eye dropper.

Figure 67. Serious blue spill.

Pick a pure blue pixel away from the hair.

3. Increase the Screen Gain from 1 to 1.05. This will clean up a little of the background.
4. Alter the Screen Balance from 0.95 to 0 as shown in Figure 68. This step is a bit subjective, but improves the blue spill.

Figure 68. Adjust the Screen Balance

5. Now let's try and get rid of that blue spill. Switch off Use Alpha Bias for Despill. From the second Viewer, pick skin tones for the Despill Bias. When you do this, the image and the screen colour will have the blue component scaled up before the key is pulled so that more blue is removed.

Figure 69. Despill Bias.

6. Look at the Final Result in the Canvas. You will notice that Miranda Richardson's face still has a number of blue highlights that we should fix. The best way to do this is using an Inside mask. We have provided one for you, so import the Mask.mov clip shown in Figure 70 and drag it to the Inside clip well.

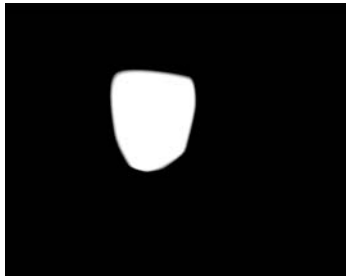

Figure 70. Inside mask.

7. To remove the blue highlights on the cheeks (Figure 71), make sure the Inside Replace is set to Soft Colour rather than Source.

Figure 71. Replace - Source.

Figure 72. Replace - Soft Colour.

8. View Final Result as shown in Figure 73.

Figure 73. Final Key.

Tutorial 4: A Red Green Screen

Using the images from the film Executive Decision, you will learn how to pull a key from a poor green screen using the Despill Bias control. You will learn how to:

- Pick the Screen Colour.
- Use Despill Bias and Alpha Bias.
- Produce a final composite.

The images you will need for this tutorial are called ExecFG.

1. Load the pictures ExecFG.mov (Figure 74) and ExecBG.mov. Apply Keylight.

Figure 74. Poor Green Screen.

The foreground image is actually a green screen shot although it doesn't look it. If you analyse the pixels it's slightly more red than green. To key this, we'll have to fool Keylight.

2. Open the ExecFG.mov clip in a new Viewer and pick the Screen Colour. You should go for the slightly darker green patch to the left of the pilot. Although feel free to

experiment picking different parts of the green screen. The initial selection gives the result shown in Figure 75.

Figure 75. Default key.

3. To fix this, we need to tell Keylight to scale down the red component to make the green the most dominant so that it keys correctly. To do this, pick colours from the pilot's mask for both the Despill Bias and Alpha Bias. Then, look at the Final Result in the Canvas. The result is shown in Figure 76.

Figure 76. Despill Bias and Alpha Bias.

4. If you look closely, the background and foreground need cleaning up. Figure 77 shows the Status View.

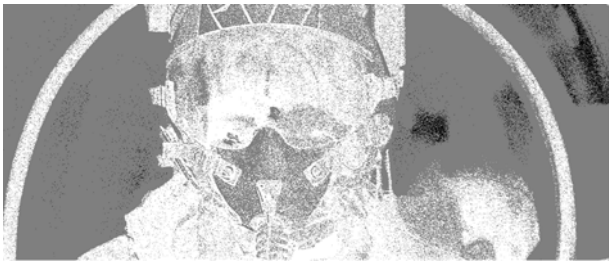

Figure 77. Status View.

We will use the Screen Matte tools to make the cockpit windows black and the pilot white.

5. Increase Clip Black to 0.2 to remove some of the foreground showing through the background. Decrease Clip White to 0.7 to improve the opacity of the foreground. Increase Screen Softness to 0.1, Screen Despot Black to 0.2 and Screen Despot White to 0.2.

Figure 78. Composite.

6. Use the Screen Replace to pull some of the original image through the composite. This improves the apparent

graininess in the foreground. Figure 79 shows the differences.

Figure 79. Close up view. The left image has Screen Replace set to Source. The right image has Screen Replace set to None.

APPENDIX A

Release Notes

This appendix describes the requirements, new features, improvements over previous versions, fixed bugs and known issues and workarounds in Keylight.

Keylight 2.0v3

This is a maintenance release of Keylight on Final Cut Pro.

Requirements

Final Cut Pro 6.0.4 or above on Mac OS X.

New Features

There are no new features in this release.

Improvements

- The plug-in now appears in the Effects > Video Filters > Keylight menu with the version number after its name, for example Keylight (2.0). This allows you to have several different versions of Keylight available on one machine.
- The Help dialog now includes an Enter Serial Number button. This opens a web browser and takes you to a page where you can activate the plug-in. For more information, see "Activating Keylight" on page 6.
- The artwork for splash screens and dialogs has been updated.
- The demo license that is automatically installed for this beta is valid until October 31st of this year.
- Change to installation. Keylight is now installed to the following directories:

/Library/Plug-ins/FxPlug/Keylight_2.0_FCP/
/Applications/TheFoundry/Keylight_2.0_FCP/Docs/
Keylight2.0<build version>_FCP.pdf

Fixed Bugs

- BUG ID 7075 - The Foundry plug-ins for Final Cut Pro were not designed to work with other applications supporting the FxPlug framework, such as Motion. When these plug-ins were used in Motion, crashes would result. This has been fixed by explicitly preventing the inadvertent use of the plug-ins in Motion. The user is notified by a splash screen that the plug-in will only function in Final Cut Pro.
- BUG ID 7093 - If the Inside Mask's Inside Replace Colour was zero, invalid ("inf") rgb values could occur. This is now fixed.
- BUG ID 7108 - After applying Keylight, the Intermediate Result would contain a binary alpha channel. This would make it less useful for using as an additional matte for further keying operations. It should have contained a continuous alpha channel. This has been fixed.
- BUG ID 8864 - Keylight would cause FCP to crash when working with larger projects containing hundreds of Keylight instances. FCP would crash when a sequence containing numerous Keylight plug-ins was copied and pasted, because the computer would run out of memory. This has been fixed.
- BUG ID 8902 - The Source Crops horizontal and vertical cropping controls were non-functional. This would have prevented simple removal of, e.g. wiring from the edges of the image. This has been fixed.

- BUG ID 8903 - The Edge Colour parameter for Inside and Outside masks did not change the effect depending on the colour. It should. This has been fixed.

Known Bugs and Workarounds

- Final Cut Pro can set video processing to render in RGB, 8-bit YUV, or high-precision YUV. In the 8-bit YUV and high-precision YUV rendering modes, frames that are rendered offline (by pressing Cmd+R, or by selecting one of the Render options in the Sequence menu) will appear slightly smoothed when compared with frames that are rendered online (by clicking on a position in the timeline). This is not a defect in Keylight, but rather applies to all plug-ins in Final Cut Pro.
- BUG ID 8895 - In some contexts, Final Cut Pro does not seem to support the use of alpha images which have not been premultiplied. We are investigating the issue. As such, the Unpremultiply Result option will therefore not yield useful images in Final Cut Pro, as Final Cut Pro will interpret the resulting images as premultiplied.
- BUG ID 8899 - Use of the Screen Matte operations Screen Dilate, Screen Softness, Screen Despot Black, and Screen Despot white can introduce faint interlacing (fielding) artefacts when the output sequence is fielded. The extent of the artefacts are best inspected in the Status view.

Keylight 2.0v2

This is a maintenance release of Keylight on Final Cut Pro.

Requirements

Final Cut Pro 6.0.4 or above on Mac OS X.

New Features

There are no new features in this release.

Improvements

There are no improvements in this release.

Fixed Bugs

Fixed instability in plug-ins caused by OS incompatibility with FLEXlm 10.8 licensing module. Upgraded FLEXlm to 10.8.6 for improved Leopard compatibility.

Known Bugs and Workarounds

There are no known bugs.

Keylight 2.0v1

This is the first release of Keylight on Final Cut Pro.

Requirements

Final Cut Pro 6.0 on Mac OS X.

New Features

This section will describe new features in later versions.

Improvements

This section will describe improvements to existing features in later versions.

Fixed Bugs

This section will describe fixed bugs in later versions.

Known Bugs and Workarounds

There are no known bugs.

APPENDIX B

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